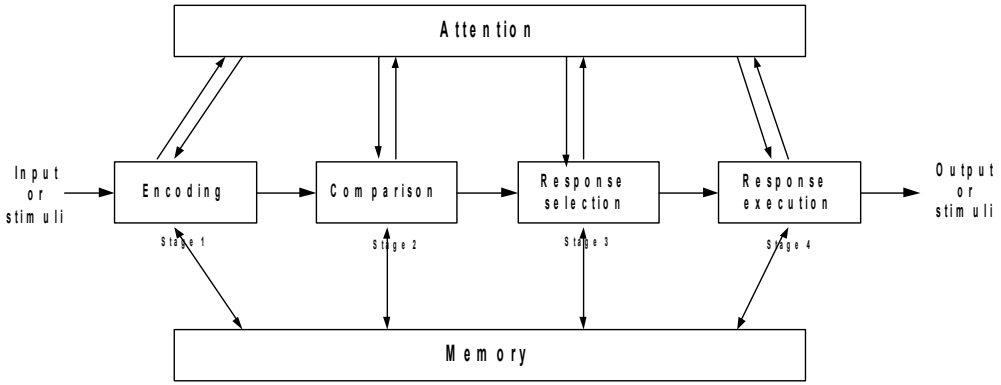
Memory in Interface Design

Lecture #8

Lesson Learned

- Extended version of human information processing model
  - Model explain how the human cognition can be viewed



  - Perceiving an information
  - Attending information
  - Storing information
    - In this model, memory plays a significant role

Agenda

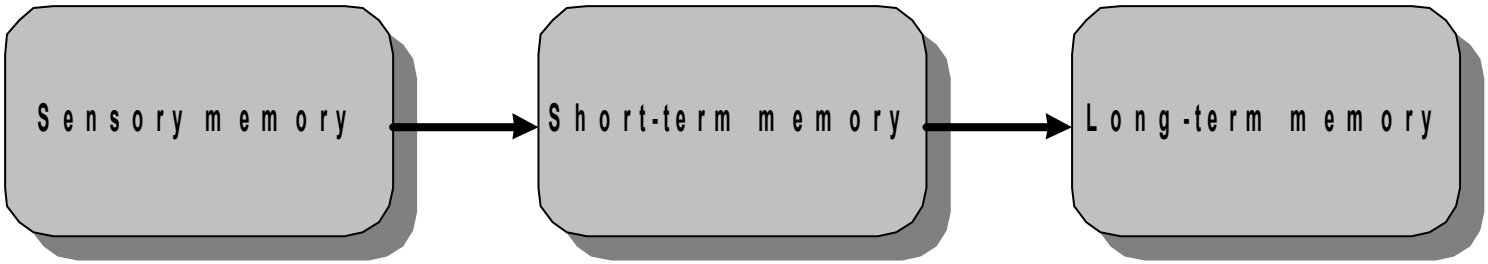
- Multi-store model of memory
- Memory in HCI design

Human Memory

Memory game

Multi-store Memory Model

- Describes more explicitly the processes in human cognition
- The model explains the three layers in memory store



Multi-store Memory Model

- Three layers in memory store
  - Sensory store
    - Modality specific
    - Holds information for a very brief period of time (a few tenth of second
  - Short-term memory store
    - Hold limited information for a short-period of time (a few seconds)
  - Long-term memory store
    - Holds information indefinitely

Sensory Store

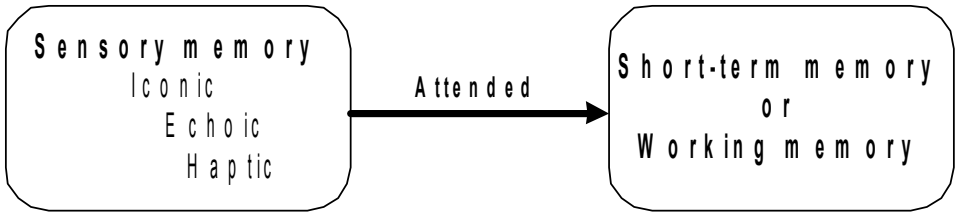
- There are three different modality specific sensory stores
  - Iconic memory for visual stimuli
    - As you all can see the display on the screen
  - Echoic memory for aural stimuli
    - As you can hear what I am telling
  - Haptic memory for tactile senses
    - As your friend pull your hair

Sensory Memory

- Information from the external world is initially registered by the specific sensory stores
  - Like input buffers holding a direct representation of sensory information
- Only a small fraction of all information entering the sensory store is attended for further processing
    - Moving a finger in front of the eyes
      - We cannot see the finger more than one place at once
    - Firework display
- The information is lost by being written over by successive information or through the process of decay
  - Information remains in sensory memory very briefly, in the order of 0.5 seconds

Short-term Memory

- Information from sensory store is attended to and selected for further processing in the short-term store
- It is also called working memory
- Information reaching the short-term memory store is actively processed and may then be transferred into the long-term memory store



Capacity of Short-term Memory

- Capacity to hold information is limited in time
  - Information remains in short-term memory very briefly, in the order of 200 ms
- Capacity to hold information is limited in amount
  - There are two basic methods for measuring memory capacity
    1. Determining the length of a sequence which can be remembered in order
    2. Items to be freely recalled in any order (say, in memory game)

Concept of 7 ± 2

- An observation by George Miller (1956)
  - The magic number 7 ± 2
  - The number is the one most often known to user interface developers
  - People can recall somewhere between 5 and 9 things at one time

Examples

- Let's see the following sequence of digits and try to write down as much of the sequence as you can
  - 364207120948
  - The average can easily recall between 5 to 9 digits

- Now try the following sequence. Did you recall that more easily?
  - 03742 58 2376

Generalization of the 7 ± 2 Rule

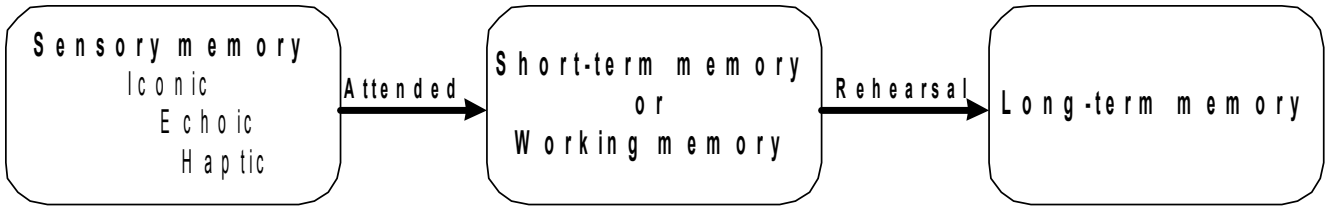
- We can remember 7 ± 2 chunks of information
  - Chunking information can increase the short-term memory capacity

- This is very much relevant in user interface design

  Example
  - Command line interface in Unix
    - A command has a number of parameters of options, to be applied in a particular order, and it is going to be applied to several files that have long path names
    - The user then has to hold the command name, its parameters and the file path names in short-term memory while he types them in
    - For the user, task may cause problems if the number of items or chunks in the command is more than 7

Long-term Memory

- Information entering the long-term memory is assumed to be permanent
- Processed information are stored as knowledge, which can be retrieved any subsequent time



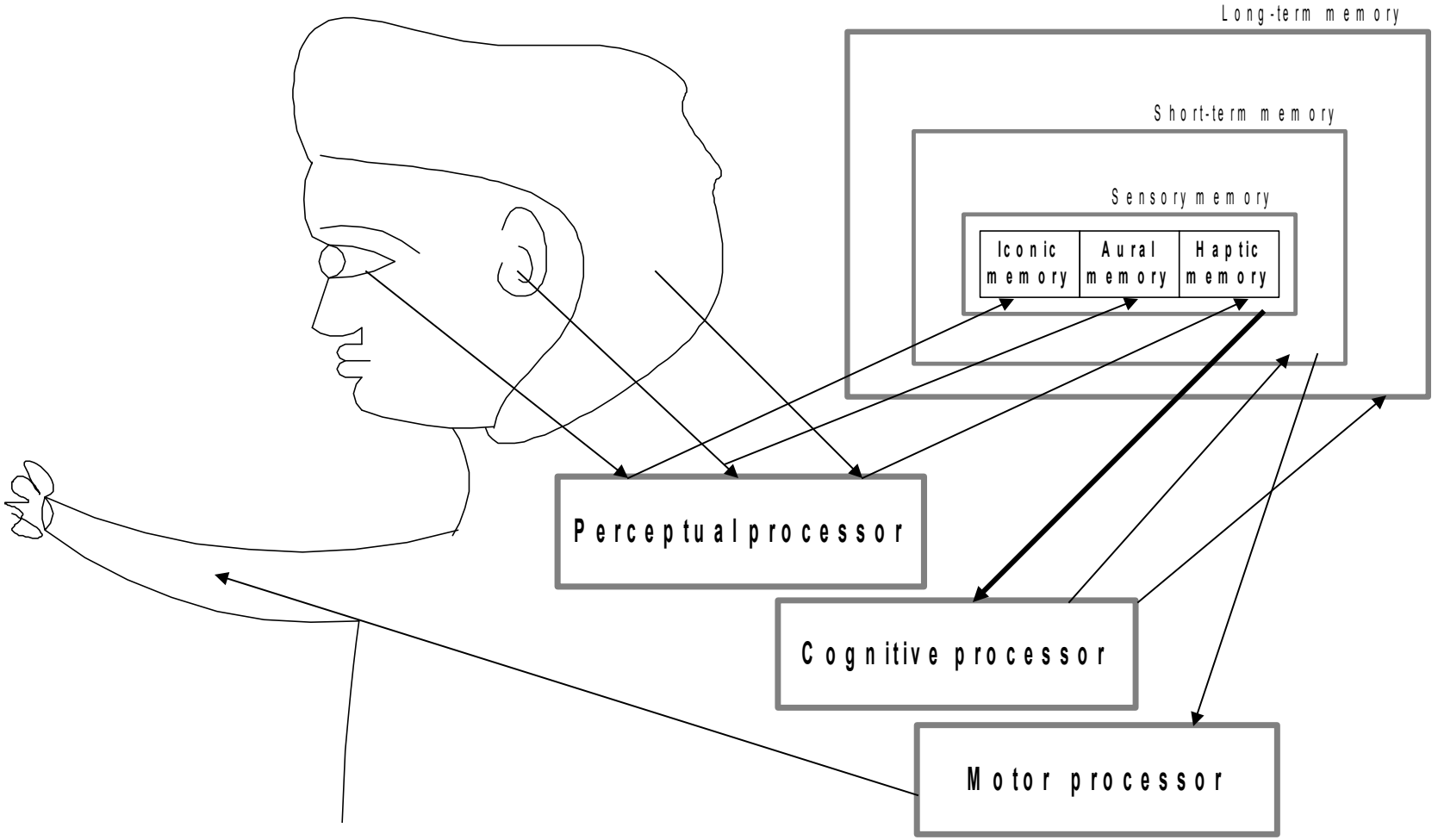
Short-term vs. Long-term Memory

- Long-term memory differs from short-term memory in a number of significant ways
  - Short-term memory has a limited capacity, whereas the long-term memory has a huge, if not unlimited, capacity
  - Short-term memory can be accessed rapidly, in the order of 70ms, whereas the long-term-memory has a relatively slow access time of approximately a tenth of a second
  - Short-term memory decays rapidly, that is, information can only be held there temporarily, in the order of 200ms. Unlike short-term memory there is little decay in long-term memory. Long-term memory recall after minutes is the same as that after hours or days

Example 1: Human Memory

- While riding a car and enjoying the roadside views
  - You see so many things: hoardings, building, statue etc. all these go to the eyes and hence to the sensory memory
  - You see a thing, say hoarding and then read it is that something written there; ultimately you can conceive what actually it is written. This is in short-term memory
  - Some building (such as the Assembly House) and you can recall those for a long time

Example 2: Human Memory



Memory Constraint in HCI

- Without memory human cannot perform any action
  - Dead means brain is ceased to exist (and hence memory)
- Human memory system is very versatile
  - Can remember many things
  - Can forget something very easily

Memory Constraint in HCI

- Memory plays important role while a human interacts with computer
  - Some operations are straightforward and take minimal effort to memorize
  - Other take forever to learn and often drop out after they have been used

Factors to Remember Stimuli

- **Meaningfulness**
  - Depth
    - More level of processing means more remembrance
  - Familiarity
    - Frequency with which it occurs in everyday life
      - Stop, Read vs. Compile, Debug, Scan
  - Imagery
    - Ability with which the words can elicit images in one mind
      - Eat, Sleep vs. Evaluate, Redo,

Meaningful Interface

- Certain items are more meaningful than others
- More memorable has obvious implication for interface design
- From the interface design point of views
  - Command names and icons should be on the basis of their meaningfulness
  - Careful consideration is required so that user should not confuse with their day-today understanding to the computing domain

Example

- Cut (user) → sever a part with some form of instrument
- Cut (MS-Word) → operation of removing a piece of text or graphics from the screen and placing it in a clipboard for further use

  Note: some user reconcile the Cut as to split a file into two parts

Designing Meaningful Command Names

- Abbreviation and control keys
  - For ‘novice’ users it is very difficult to learn and subsequently remember the abbreviations or control key combinations
    - Ctrl + = | Ctrl + R | Ctrl + E
- Abstract and quite arbitrary command names
    - cat, grep, lint, mv, pr, lpr
  - Not at all support to infrequent users
  - Who use several systems with different command names or abbreviations for the same functionality

Designing Meaningful Command Names

- Select command names to consider the contextual, cultural, and user characteristics
  - If a particular application is to be used in a specific design culture, then the selection of names that are already used in the design world may be appropriate
  - An editing tool developed for use by children should also try to select names that the children already understood

Designing Meaningful Icons

- As with command names, there are several factors that determine the meaningfulness of icons
  - Context
    - In which the icon is being used
  - Function
    - For which it is being used
  - Representational forms
    - The surface form of representation
  - Underlying concepts
    - The nature that is being represented
  - Animated icons
    - Showing the behavior with multimedia

Meaningful Icons: Context

- Men's shoe and Women's high-heeled shoe in a public toilets or in a restaurant vs. same information sign in a shopping mall
- Understanding the meaning of icons should be context independent as far as possible
- The meaning of icons when used in more general context should be unambiguous

Meaningful Icons: Function

- Increasingly, icons are being used for a range of functions

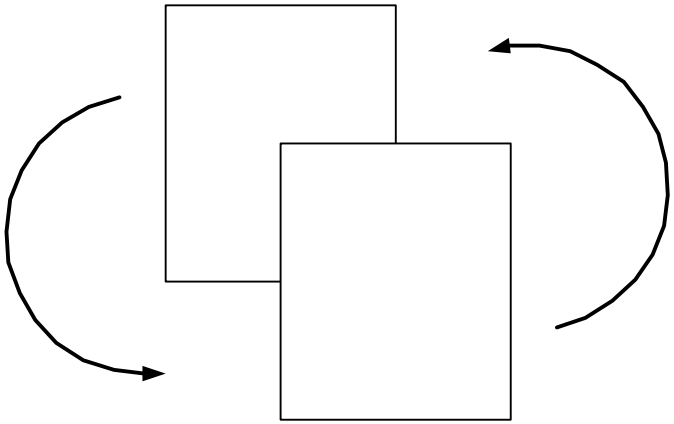
Function	Example
Labeling	Menu item
Indicating	System state
Warning	Error message
Identifying	File storage
Manipulating	Tools for zooming and shrinking
Container	Object placing discard items

- The type of tasks for which they are being used is an important factor in determining their meaningfulness

- Icons should provide useful cues to guide the search for information
  - e.g. web page, painting tools etc.

Meaningful Icons: Representational Form

- The extent to which the meaning of an icon can be understood will depend a lot on how it is represented
- Essentially there are three forms
  - The use of concrete object
  - The use of abstract symbol (such as arrows, circles, dots, lines)
  - A combination of the two



Meaningful Icons: Underlying Concepts

- The extent to which any form will be meaningful also depends on the type of concept that is being represented
- The easiest types to represent the concrete objects such as files and folders, where icons can be drawn to have a physical resemblance to the actual objects
- Icons can be designed to represent the concept only through less direct means, such as by indirect analogy
  - E.g. icon with elephant to represent the concept heavy
- In some cases, the meaning of the icon will initially need to be learned and after that easy to recall

Meaningful Icons: Animated Icons

- By animating the underlying function of the icons it is possible that complex and abstract process can be more effectively portrayed
- Animated icons are more easier to recall and more meaningful
- Animated icons depict both the static view as well as dynamic view: a combination of the both of the world
- To be specific, have to be designed to focus on the key aspects of the function; otherwise the animation may prove to be counterproductive and result in a confusing set of moving elements being displayed

Recommended Materials

- My Home page

  http://facweb.iitkgp.ernet.in/~dsamanta

  (For the presentation slides of the current lecture

- Book

  Human-Computer Interaction by Jenny Preece and et al. Addison-Wesley, New York

  Chapter 5